Fleas associated with the northern pocket gopher (*Thomomys talpoides*) in Elbert County, Colorado

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It is widely accepted that members of the flea genus *Foxella* Wagner, 1929 are true parasites of pocket gophers. Miller and Ward (1960) found all 4 species of Colorado pocket gophers (*Pappogeomys castanops* Baird, 1852; *Geomys bursarius* Shaw, 1800; *Thomomys bottae* Eydoux and Gervais, 1836; and *T. talpoides* Richardson, 1828) infested with *Foxella ignota* Baker, 1895. They performed their survey during August 1957 in the southeastern part of Colorado, where the northern pocket gopher (*T. talpoides*) was the most abundant host. In an earlier study the same species of flea was recovered from northern pocket gophers in Park County (Eads 1949). These and other reports of *F. ignota* from the Rocky Mountains area have not often indicated a subspecies designation because of considerable morphological variation (Hubbard 1947).

Several flea genera have been reported from *T. talpoides* throughout its range. These include *Foxella* Wagner, 1929; *Dactylopsylla* Jordan, 1929; and *Spicata* I. Fox, 1940 (Lewis 2003). These genera can also occur on the other 3 pocket gopher species in Colorado (*G. bursarius*, *T. bottae*, and *E. castanops*). The *F. ignota* complex ranges from Indiana (Lake and Newton Counties), where they are found on *G. bursarius*; westward through Montana, Wyoming, and Colorado to Oregon and into California, where they are found on *T. bottae*; and north into Canada from Manitoba to British Columbia and south into Arizona, New Mexico, Texas, and Mexico (R.E. Lewis personal communication). According to Lewis, fleas within the complex increase in size from east to west and from north to south. Holland (1985) lists 12 other species from *T. talpoides*, but these are typically found on ecological associates such as woodrats, ground squirrels, mice, and voles.

Northern pocket gophers have an extensive range in North America similar to, but somewhat smaller than, that of the genus *Foxella*. The range of northern pocket gophers extends westward from the Dakotas and Nebraska to include Colorado, Wyoming, Montana, Idaho, and northward into the southern portion of the Canadian provinces from Manitoba to British Columbia. In the western United States, this rodent occurs east of the Cascades in Washington and Oregon but has a more limited distribution in northern California, Utah, Nevada, New Mexico, and Arizona (Baker et al. 2003).

Longanecker and Burroughs (1952) studied the relationship between temperature, humidity, and flea abundance in burrows of the California
ground squirrel, *Spermophilus beecheyi* Richardson, 1829. They also found that numbers of *Hoplopsyllus anomalus* Baker, 1904 varied during the year, with a marked increase in abundance during the warmer months. Reichardt and Galloway (1994) studied the incidence and prevalence of *Oropsylla bruneri* Baker, 1895 on *S. franklinii* Sabine, 1822 in Manitoba, with emphasis on the reproductive status of the female fleas and their nondependence on the host’s hormones for timing of reproduction. They found that the proportion of female fleas on *S. franklinii* exceeded male fleas during some months. Lang (1996) investigated the effect of biotic and abiotic factors on abundance of *Oropsylla montana* Baker, 1895 and *H. anomalus* on *S. beecheyi*, and of *Orchopeas sexdentatus* Baker, 1904 on woodrats in southern California. He found an increased abundance of *O. montana* and *O. sexdentatus* correlated with decreased ambient temperature in autumn and early winter. *Hoplopsyllus anomalus* abundance, however, increased with the warmer temperatures of summer. None of the 3 species of fleas appeared hormonally synchronized with the breeding cycle of their hosts. Similar studies have not been reported regarding flea abundance on *T. talpoides*.

We hypothesized that the number of fleas infesting this host might vary over the course of a calendar year because of the activity and abundance of hosts, as well as seasonal changes in temperature and humidity. In this study we examined flea abundance on hosts but did not investigate abiotic factors.

**MATERIALS AND METHODS**

We collected 247 *T. talpoides* (99 males, 148 females) in the Kiowa Creek valley, Elbert County, Colorado. Pocket gophers were collected in both irrigated and nonirrigated alfalfa fields. Animals were trapped for 13 months using Death-Klutch-1 (DK-1) traps (October 2002–October 2003). Animals were placed in Ziploc® plastic bags and were stored frozen. When later thawed, they were brushed for fleas over a white enamel pan. Those collected were placed in 70% ethanol for short-term storage and later cleared in 10% KOH, neutralized, dehydrated in ethanol and then in xylene, and finally mounted on slides using Canada balsam. Fleas were examined microscopically for identity and sex. Flea abundance was compared using descriptive statistical methods for differences based on time of year as well as host sex.

**RESULTS**

A total of 532 fleas were collected from 247 *T. talpoides*. Of these fleas, 526 were identified as *F. i. ignota* (269 males, 257 females), 2 males and 1 female as *S. rara* I. Fox, 1940, 1 female as *H. dippiei* ssp., 1 male as *O. idahoensis* Baker, 1904, and 1 female as *Oropsylla* (*Opisocrostis*) sp. Numbers of fleas per host ranged from 0 to 26, and median numbers are shown in Table 1. Throughout the study the median flea infestation rate remained between 0 and 2 except in May when it rose to 5. Mean intensity (total number of fleas divided by the number of hosts with fleas) and relative density (total number of fleas divided by the number of hosts examined) of fleas per host are also shown in Table 1. While median number of fleas per host peaked in May, mean intensity of fleas peaked in April and declined slightly in May. Relative density, however, mirrored the peak of the median in May. All 3 values dropped slightly in June and then rose slightly in July. Male pocket gophers constituted 40% of those collected; 71.7% of them had fleas, while 56.8% of the females were infested. In all, 62.8% of the animals had ≥1 fleas. The ratio of male to female fleas on hosts varied by month and by sex of the host animal. Except during December, February, and July, a higher percentage of male pocket gophers had fleas than did females (Table 2). The ratio of male to female fleas for the duration of the study was 1.05, but the ratio showed considerable variation by month and by sex of the host.

**DISCUSSION**

**Flea Species**

The most abundant flea collected was *F. i. ignota* (526/532). This subspecies is the only member of the genus found in central Colorado east of the Rocky Mountains, and it is the dominant flea on all 4 species of pocket gophers in Colorado. Miller and Ward (1960) did not designate which subspecies of *F. ignota* or of *T. talpoides* they collected. We assume that it
was *F. i. ignota* from *T. talpoides* populations if they trapped on the eastern side of the Front Range.

Some members of the genus *Spicata* have been described as possible nest fleas (Hubbard 1947). *Spicata rara* was first collected from *T. talpoides* in Jackson County, Colorado, by I. Fox (1940) and subsequently reported from *Thomomys* sp. in Iron County, Utah (Stark 1959). Additional, but limited, collections have been made in Montezuma County, Colorado, and in Big Horn County, Wyoming (Lewis 2003). Thus far, all collection sites are separated by 150–300 miles. Lewis suggested that *S. rara* might be a “winter species,” with higher population numbers present in pocket gopher burrows during the winter months. The 3 specimens we collected were taken in January, February, and May, thus supporting this assertion. Very few *S. rara* have been collected from any single locale, but with this new Elbert County record, we believe that *S. rara* is widely dispersed in low numbers throughout Colorado and adjacent montane regions.

*Hystrichopsylla dippiei* ssp. was first reported from mustelids, but it has also been taken from a wide array of sciurids, cricetids, and geomyid rodents including *T. talpoides* (Hubbard 1947, Holland 1985). Lewis and Lewis (1994) stated that members of this genus show little host specificity, occurring on many different species of small mammals. According to Hubbard (1947) and Holland (1957), these large fleas are usually collected as single individuals or in groups of 2 and 3. Unlike *S. rara*, however, *H. dippiei* ssp. can occur on ecological associates that use pocket gopher burrows.

*Oropsylla idahoensis* has a wide distribution in western North America, including collections from Colorado ground squirrels (Hubbard 1947). According to Lewis (2002), *O. idahoensis* has an equally broad host range, having been reported from 54 species, 5 of which are birds. A few thirteen-lined ground squirrels, *S. tridecemlineatus*, were found in pocket gopher burrows during our study, suggesting that this host was the source of the single *O. idahoensis* collected.

The single flea identified as *Oropsylla* (*Opiscrostis*) sp. was a female. It may belong to the species *O. idahoensis* or other closely related species, but males are required for a specific identification.

**Flea Abundance**

The number of fleas present on *T. talpoides* not only varied seasonally but also varied by sex of the host. Seasonal abundance was similar to that which Longanecker and Burroughs (1952) described for *H. anomalus* from *S. beecheyi* in California. As the temperature increased from April through July, so too did the total number of fleas collected from *T. talpoides*. Although we did not measure temperature and humidity levels within pocket gopher burrows, we assumed that temperatures rose and humidity increased in warmer months in the burrows.

Reichardt and Galloway (1994) live-trapped *S. franklinii* biweekly and found that female fleas outnumbered male fleas during most of
their study, except during early May and late June or early July. They suggested that the temporarily altered sex ratio represented newly emerged male fleas. We found that male *F. ignota* outnumbered female *F. ignota* about half the time on hosts of both sexes (Table 2) and that there was a large peak in the male-to-female ratio from March through May, with smaller peaks in December and October. This may represent a postemergent increase of male fleas.

Mead-Briggs et al. (1975) reported the migration of the rabbit flea, *Spilopsyllus cuniculi* (Dale), from bucks to does of *Oryctolagus cuniculus* (L.) in response to reproductive cues. Does yielded greater numbers of fleas than males during mid- to late pregnancy. Our study indicated no evidence of a similar hormonally induced migration of *F. i. ignota* onto female pocket gophers. The percent of male pocket gophers with fleas from March through June was greater than that for females even though these months encompass the host’s breeding season (Hansen 1960). The ratio of fleas on female pocket gophers did not increase during this time, as would be expected if hormonal changes during pregnancy of these animals led to synchronization of flea breeding. Male *T. talpoides* exhibited a higher percentage of flea infestation than females for all but 3 months (Table 2). This may be a collection artifact, but it is similar to the findings of Longanecker and Burroughs (1952), Lang (1996), and Larson et al. (1996), because the numbers of fleas peaked during a period of 3–4 months, possibly related to changes in ambient temperature and relative humidity within the burrows.

During the summer months, when many young-of-the-year are present, factors such as increased temperature, elevated humidity in the burrows, and greater numbers of gophers might account for the higher numbers of fleas (Table 1).

 Further studies of *F. i. ignota* in Colorado could explore the timing of flea reproduction, numbers of individuals produced in one pocket gopher burrow, and the sex ratio of the newly emerged cohort. A yearlong study to monitor temperature and relative humidity in the burrows would be interesting but labor intensive. Such data might explain seasonal fluctuations in flea abundance and elucidate their population dynamics on northern pocket gophers.

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**TABLE 2. Flea infestation on male and female *Thomomys talpoides* in (2002–2003) Elbert Co., Colorado, by month.** The standard deviation is ±0.197 for males and ±0.167 for females, and the number of hosts is in parentheses after each percent.

<table>
<thead>
<tr>
<th>Month</th>
<th>Number of <em>T. talpoides</em></th>
<th>Percent of ♀<em>T. talpoides</em> with fleas</th>
<th>Ratio of ♀:♂ fleas on ♀ hosts</th>
<th>Percent of ♀<em>T. talpoides</em> with fleas</th>
<th>Ratio of ♀:♂ fleas on ♂ hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>26</td>
<td>73 (11)</td>
<td>1.38</td>
<td>53 (15)</td>
<td>2</td>
</tr>
<tr>
<td>November</td>
<td>21</td>
<td>57 (7)</td>
<td>2</td>
<td>50 (14)</td>
<td>0.53</td>
</tr>
<tr>
<td>December</td>
<td>10</td>
<td>33 (3)</td>
<td>0</td>
<td>57 (7)</td>
<td>1</td>
</tr>
<tr>
<td>January</td>
<td>20</td>
<td>78 (9)</td>
<td>0.5</td>
<td>55 (11)</td>
<td>2.5</td>
</tr>
<tr>
<td>February</td>
<td>20</td>
<td>71 (7)</td>
<td>3.5</td>
<td>77 (13)</td>
<td>0.77</td>
</tr>
<tr>
<td>March</td>
<td>11</td>
<td>100 (4)</td>
<td>4</td>
<td>43 (7)</td>
<td>0.67</td>
</tr>
<tr>
<td>April</td>
<td>16</td>
<td>60 (10)</td>
<td>1.72</td>
<td>33 (6)</td>
<td>1.25</td>
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<tr>
<td>May</td>
<td>14</td>
<td>100 (4)</td>
<td>1.18</td>
<td>90 (10)</td>
<td>1.08</td>
</tr>
<tr>
<td>June</td>
<td>23</td>
<td>83 (6)</td>
<td>0.67</td>
<td>76 (17)</td>
<td>0.84</td>
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<tr>
<td>July</td>
<td>22</td>
<td>50 (6)</td>
<td>0.8</td>
<td>63 (16)</td>
<td>1.18</td>
</tr>
<tr>
<td>August</td>
<td>29</td>
<td>57 (12)</td>
<td>0.8</td>
<td>33 (17)</td>
<td>0.5</td>
</tr>
<tr>
<td>September</td>
<td>23</td>
<td>70 (10)</td>
<td>0.56</td>
<td>54 (13)</td>
<td>1.27</td>
</tr>
<tr>
<td>October</td>
<td>12</td>
<td>90 (10)</td>
<td>0.46</td>
<td>50 (2)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Means</strong></td>
<td></td>
<td>71 (99)</td>
<td>1.41</td>
<td>56 (148)</td>
<td>1.13</td>
</tr>
</tbody>
</table>
LITERATURE CITED


LANG, J.D. 1996. Factors affecting the seasonal abundance of ground squirrel and woodrat fleas (Siphonaptera) in San Diego County, California. Journal of Medical Entomology 33:790–804.


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